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APPLICATION NUMBER: *60/672,834*
FILING DATE: *April 19, 2005*
RELATED PCT APPLICATION NUMBER: *PCT/US06/13765*

THE COUNTRY CODE AND NUMBER OF YOUR PRIORITY APPLICATION, TO BE USED FOR FILING ABROAD UNDER THE PARIS CONVENTION, IS *US60/672,834*

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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

Express Mail Label No. EV 363553689 US

INVENTOR(S)		
Given Name (first and middle (if any))	Family Name or Surname	Residence (City and either State or Foreign Country)
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J. Casey	Schutz	Crescent, PA

Additional inventors are being named on the _____ *separately numbered sheets attached hereto*

TITLE OF THE INVENTION (500 characters max):

METHOD FOR PRODUCING ACTIVATED LIME FOR REMOVAL OF ACID GASES FROM A COMBUSTION GAS

Direct all correspondence to: **CORRESPONDENCE ADDRESS**

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ENCLOSED APPLICATION PARTS ***(check all that apply)***

☐ Application Data Sheet. See 37 CFR 1.76

☑ Specification *Number of Pages* 5

☑ Drawing(s) *Number of Sheets* 2

☐ CD(s), Number of CDs _____

☐ Other (specify) _____

Application Size Fee: If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).

METHOD OF PAYMENT OF FILING FEES AND APPLICATION SIZE FEE FOR THIS PROVISIONAL APPLICATION FOR PATENT

☐ Applicant claims small entity status. See 37 CFR 1.27.

☑ A check or money order is enclosed to cover the filing fee and application size fee (if applicable).

☐ Payment by credit card. Form PTO-2038 is attached

☐ The Director is hereby authorized to charge the filing fee and application size fee (if applicable) or credit any overpayment to Deposit Account Number: 16-0485. A duplicative copy of this form is enclosed for fee processing.

TOTAL FEE AMOUNT ($) 200.00

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

☑ No.

☐ Yes, the name of the U.S. Government agency and the Government contract number are: _____

SIGNATURE _____ Date April 19, 2005

TYPED or PRINTED NAME William G. Kratz, Jr. REGISTRATION NO. 22,631 *(if appropriate)*

TELEPHONE 412-281-2931 Docket Number: 04037

USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT

Docket No.: 04037

CERTIFICATE OF MAILING

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I hereby certify that, on April 19, 2005, the attached Provisional Patent Application and Assignment were deposited with the United States Postal Service as Express Mail utilizing the Express Mail Post Office to Addressee Service, postage pre-paid, addressed to:

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Barbara A. Konopski
(Signature)

Barbara A. Konopski

April 19, 2005

METHOD FOR PRODUCING ACTIVATED LIME FOR REMOVAL OF ACID GASES FROM A COMBUSTION GAS

BACKGROUND OF THE INVENTION

The present invention relates to a method of producing an activated calcium oxide for use in the removal of acid gases, such as sulfur trioxide vapor, sulfur dioxide, hydrogen chloride and hydrogen fluoride from combustion gases, such as those produced in industrial plants.

Hydrated lime (calcium hydroxide) has been used for capture of sulfuric acid or sulfur trioxide vapor. For sulfur trioxide control, hydrated lime has been injected into flue gas in a coal-fired power plant ahead of a particulate collector, usually an electrostatic precipitator (ESP). Flue gas temperature at this location is 300-350°F. Capture of SO_3 is marginally effective with normal hydrated limes. The specific surface area of normal hydrated lime ranges from 10-23 square meters per gram, and the specific surface area is unchanged upon injection at this temperature range. Specially prepared hydrated limes with higher than normal specific surface areas ranging from 25-38 square meters per gram are more effective at capturing sulfur trioxide via injection ahead of an ESP. Specially prepared hydrated limes include thus prepared with additives (glycols, amines, and alcohols) and those prepared with excess water. The disadvantages of these specially prepared hydrated limes include cost of additives and cost from drying excess water from the product. Also, additives may contaminate other hydrated lime products produced in the same hydration plant and make these other products unsuitable. Although a number of patents on specially prepared hydrated limes claim substantially improved specific surface areas, none of these products are produced commercially in the United States due to the noted disadvantages.

Although it is already well-known that thermal decomposition of calcium hydroxide (to calcium oxide and water vapor) increases its reactivity with sulfur dioxide, it is not well-known that thermal decomposition may also increase reactivity with sulfur trioxide. Also, although it is well-known that calcium hydroxide decomposes near 1076°F, it is not well-known that decomposition can begin at as low as 750°F. Test data shows that partial decomposition at 750°F yields a large increase in the number of active sites available for acid gas absorption. Moreover, test data shows that decomposition at the well-known temperature of 1076°F yields fewer active sites than decomposition at 750°F.

One aspect of the invention is that calcium hydroxide is prepared from hydrated lime and is activated for acid gas capture at a much lower temperature than the well-known decomposition temperature of 1076°F for calcium hydroxide (reference, CRC Handbook of Chemistry and Physics, 53 ed., p. B-77).

SUMMARY OF THE INVENTION

An activated lime for use in the removal of acid gases from a combustion gas stream is prepared by thermally decomposing calcium hydroxide to produce calcium oxide by contacting the calcium hydroxide with a heated gaseous stream having a temperature of between 750-950°F, such that calcium oxide is produced that has a specific surface area of between about 36-42 square meters per gram, and collecting the resultant calcium oxide so produced for use later in contact with a combustion gas stream to remove acid gases therefrom.

DETAILED DESCRIPTION OF THE INVENTION

An activated lime is produced according to the present method for use in removing acid gases from a combustion gas stream. Examples of acid gases in a combustion gas stream include sulfur trioxide, sulfur dioxide, hydrogen chloride, hydrogen fluoride, and the like.

In the present method, the calcium hydroxide (hydrated lime) is contacted with a hot gas stream at a temperature of between 750-950°F, which gas stream may comprise a combustion gas stream or air.

The calcium hydroxide may be activated at any source thereof, for example, from hydration of lime at a lime production facility, and collected and then shipped for use at a site for removal of acid gases from a combustion gas stream.

Fig. 1 illustrates an embodiment where a combustion gas stream from combuster 1 is at a temperature below about 750°F. The combustion gas stream flows through line 2 to a contactor 3. At least a portion of the combustion gas stream is diverted through line 4 to a heater 5 where the combustion gas stream is heated to a temperature between 750-950°F and then passed through line 6. Calcium hydroxide from a source 7 is charged through line 8 to the line 6 for contact with the heated combustion gas stream. The calcium hydroxide is thermally decomposed to provide an activated lime having a specific surface area of between about 36-42 square meters per gram and is collected in collector 9. The activated lime is charged from collector 9 through line 10 to the contactor 3 where it reacts with and removes acid gases from the combustion gas stream fed through line 2. The contactor 3 may be a separate unit into which the line 2 feeds or may be a portion of the contactor line 2. After contact, the clean gas stream is passed

passed through line 11 to a separator 12, such as an electrostatic precipitator, and solids are removed therefrom through line 13, while the combustion gas stream, with acid gases removed therefrom, is discharged through line 14.

In the embodiment illustrated in Fig. 2, hot air is used to heat and decompose the calcium hydroxide. As illustrated, a combustion gas stream from combustor 15, at a temperature below about 750°F flows through line 16 to a contactor 17. Hot air, at a temperature of between 750-950°F, from a source 18, is passed through line 19. Calcium hydroxide from a source 20 is charged through line 21 to the line 19 for contact with the heated air stream. The calcium hydroxide is thermally decomposed to provide an activated lime having a specific surface area of between 36-42 square meters per gram and is collected in collector 22. The activated lime is charged from collector 22 through line 23 to the contactor 17 where it reacts with acid gases from the combustion gas stream fed through line 16. After contact, the clean gas stream is passed through line 24 to a separator 25, such as an electrostatic precipitator, and solids are removed therefrom through line 26, while the combustion gas stream, with acid gases removed therefrom, is discharged through line 27.

Fig. 3 shows the number of active absorption sites (as specific surface area, square meters per gram) vs. temperature for thermal decomposition in air of three different hydrated limes. The data clearly shows that the specific surface area increases sharply at about 750°F and declines rapidly at temperatures above about 950°F.

What is Claimed is:

1. A method of forming an activated lime for the removal of acid gases from a combustion gas stream comprising;

thermally decomposing calcium hydroxide to produce calcium oxide by contacting the calcium hydroxide with a gaseous stream having a temperature of between 750–950°F whereby calcium oxide is produced having a specific surface area of between about 36 – 42 square meters per gram; and

collecting the calcium oxide so produced for use in contact with a combustion gas stream to remove acid gases therefrom.

2. The method of forming an activated lime for removal of acid gases from a combustion gas stream as defined in Claim 1 wherein said temperature is between about 750-850°F.

3. The method of forming an activated lime for removal of acid gases from a combustion gas stream as defined in Claim 1 wherein said gaseous stream is a combustion gas stream.

4. The method of forming an activated lime for removal of acid gases from a combustion gas stream as defined in Claim 1 wherein said gaseous stream is air.

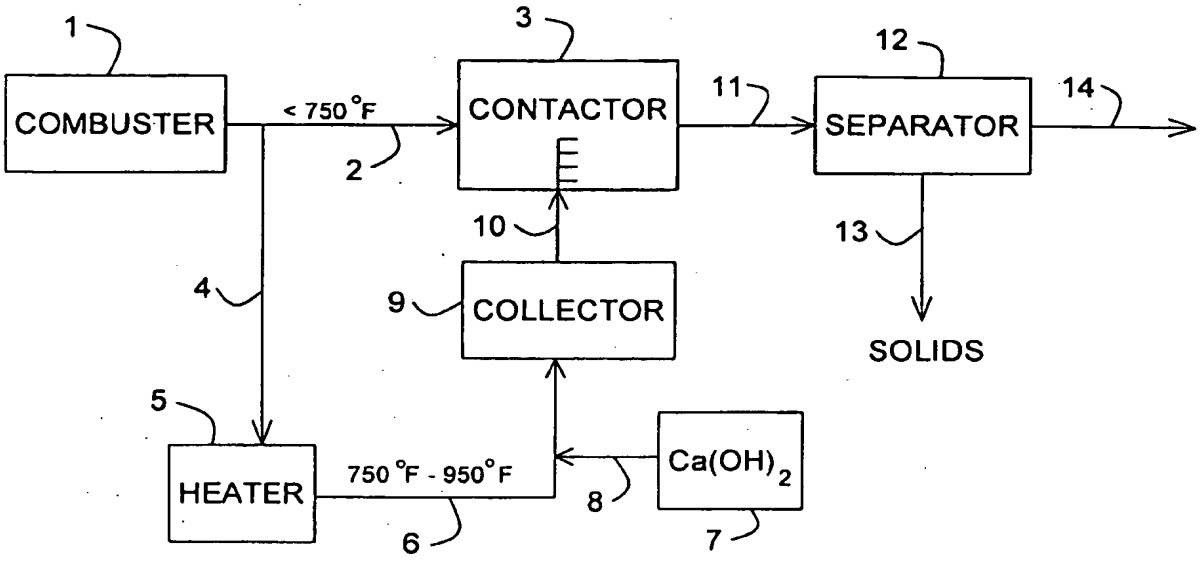
1
COMBUSTER
< 750°F
2
3
CONTACTOR
11
12
SEPARATOR
14
13
SOLIDS
10
4
9
COLLECTOR
5
HEATER
750°F - 950°F
6
8
Ca(OH)2
7

FIG. 1

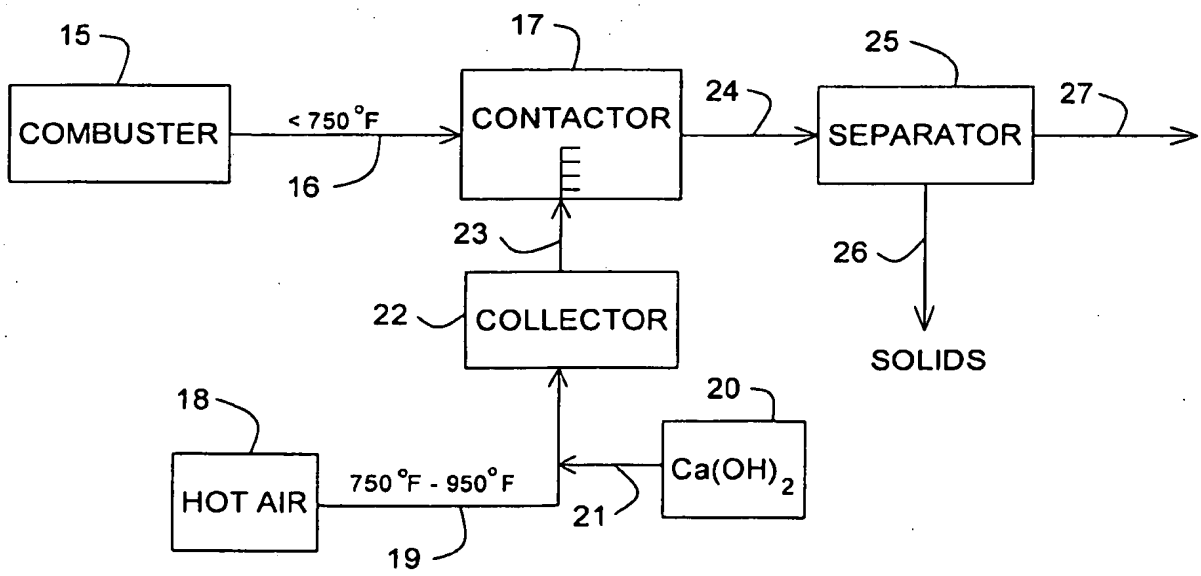
15
COMBUSTER
< 750°F
16
17
CONTACTOR
24
25
SEPARATOR
27
26
SOLIDS
23
22
COLLECTOR
18
HOT AIR
750°F - 950°F
19
21
20
Ca(OH)2

FIG. 2

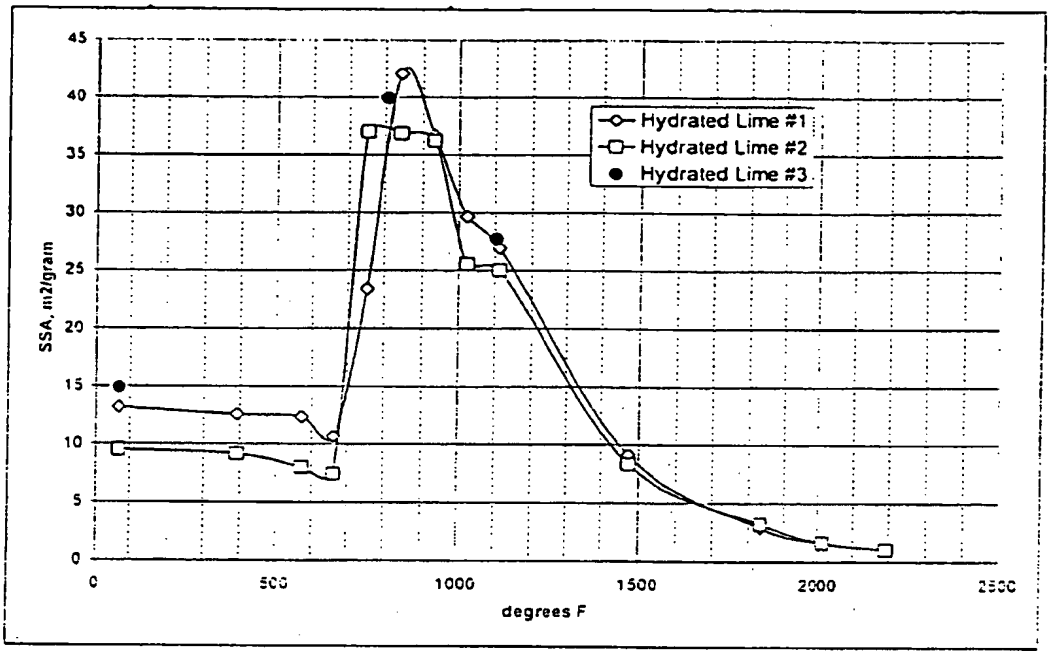
45
40
35
30
25
20
15
10
5
0
SSA, m2/gram
0
500
1000
1500
2000
2500
degrees F
Hydrated Lime #1
Hydrated Lime #2
Hydrated Lime #3

FIG. 3